CHAPTER 4

REPRODUCTION EQUIPMENT

Overview

Introduction

A Navy Graphics shop contains a wide variety of equipment. To use the equipment effectively and safely, you must have a working knowledge of its characteristics, limitations, and operating and maintenance procedures. This chapter covers the more common types of graphics shop reproduction equipment.

Objectives

The material in this chapter enables you to do the following:

- Recognize the need for periodic cleaning and inspecting of shop reproduction equipment.
- Select copier options and maintain toner levels.
- Describe operator checks and adjustments on diazo-type reproduction machines.
- Explain phototypesetter operation and maintenance.
- Identify operator adjustments on pressure process lettering machines.
- Adjust copy camera settings and explain the procedures for completing operator checks.

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Acronyms

The following table contains a list of acronyms you must know to understand the material in this chapter.

Acronym	Meaning
CRT	Cathode-Ray Tube
DPI	Dots Per Inch
ISO	International Standards Organization
K	Kelvin
LASER	Light Amplification by Simulated Emission of Radiation
LED	Light Emitting Diode
LPI	Lines Per Inch
OCR	Optical Character Recognition
PIXEL	Picture Element
RIP	Raster Image Processor
SLR	Single Lens Reflex

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Overview, Continued

In this chapter This chapter covers the following topics:

General Safety Precautions

Introduction

Since most shop equipment is electrically driven, you must observe several precautions to avoid personal injury and injury of others and to prevent damage to the equipment.

General precautions

Inspect reproduction equipment regularly and have all repairs done by a qualified electrician.

Common electrical discrepancies are as follows:

- worn or frayed cords,
- bare wires, and
- broken/malfunctioning switches.

Avoid extensive use of extension cords. Plug units into safety approved surge protectors. Make sure power to the equipment is off before cleaning any equipment.

CAUTION: Never touch an energized electrical plug, switch, or any part of electrically operated equipment when you have wet hands, or while you are standing in water on a wet deck.

Environmental precautions

Do not expose electrically powered reproduction equipment to the elements. During field day, do not allow water to seep under the equipment near the electrical mechanisms. Allow for maximum air circulation when you select a position for placing equipment, particularly if the equipment produces fumes.

General Maintenance

Introduction	Proper maintenance extends the useful life of equipment and ensures that the equipment is in an optimum state of readiness. It is aggravating to need a piece of equipment for a rush job and discover that you have to clean it up before you can use it.
General maintenance	The cleaner you keep your equipment, the better off you are. Specific maintenance requirements for particular pieces of equipment should appear near the equipment to which they pertain. In general, keep debris away nom keyboards and keys. Clean monitors and mirrors periodically. Do not allow food and especially drink near equipment and keyboards.
Equipment movement	Do not move equipment around the shop excessively. Protect equipment from unnecessary jarring and secure for sea before getting under way.

Copiers

Introduction

DMs interface with copiers daily. Copiers offer a selection of timesaving options and provide good resolution reproductions. As copiers become more sophisticated, they assume a more versatile and valuable role in the creative process.

Copier needs

Command or shop needs determine the type of copier purchased or leased. Copiers are classified by volume range and speed. The command or shop may need a color copier or a black-and-white copier. Available options also influence the choice of a copier.

Volume range and speed

A low-volume range indicates the need for a personal copier which tends to be slow in operation. A medium-range copier is for moderate use, and a high-volume range indicates a heavy use, multifunction, high-speed copier found in reprographic departments and printshops.

Standard copiers

Standard copiers produce basic black images on either white or colored paper. These images appear through electrostatic, thermographic, or digital technology. Speed, resolution, and volume are the primary variables that influence the selection of a standard copier.

Color copiers

Color copiers make the image appear through thermal fusion or laser technology.

THERMAL: A copier scans an image at 300 dots per inch (DPI) and prints through a ribbon that converts the image into a combination of four colors. Heat transfers and fixes the image to paper.

LASER: Laser copiers use color toner instead of ribbon to create an image. The color toner is available in cyan, magenta, yellow, and black. They use digital technology to act as a laser printer, reproducing the image in very high resolution.

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Options

Most copiers are user friendly. Standard symbology or icons represent options and often labels do not appear on the facia of the machine. Most copiers provide the following options.

ONE-SIDED: One side of the master copies to one side of a page.

ONE- to TWO-SIDED: A one-sided master copied to two sides of a page.

TWO-SIDED to TWO-SIDED: A two-sided master copied to two sides of a page.

COLLATE: Combines pages of different information.

SORT: Sorts pages into like information.

STAPLE: A staple placed in either the upper left-hand comer or the left side of the document.

LIGHT/DARK: An increase or decrease in the contrast of the image.

REDUCE: Reduction of the image, either in stepped increments or variable increments.

ENLARGE: Enlargement of an image, either in stepped increments or variable increments.

ELONGATE: Stretching an image to appear panoramic with some horizontal distortion.

Figure 4-1 shows typical copier option icons.

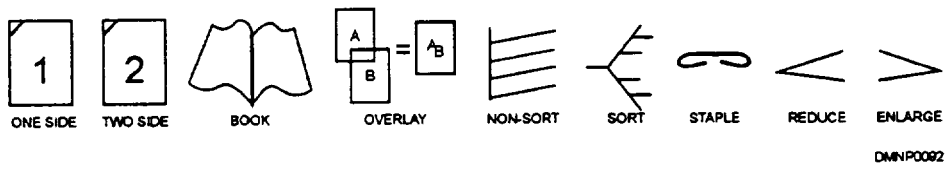

Figure 4-1. -Sample copier symbols.

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Copiers, Continued

Copier use and operator checks

Copiers sometimes confuse instructions programmed into them by an Should a copier jam or continually malfunction, call a "key" operator. Key operators are command designated personnel that have formal training in copier repair/adjustment.

To use a standard copier, follow this table:

Step	Action
1	Turn machine on and allow it to warm to operating temperature.
2	Inspect copier paper supply.
3	Inspect copier output tray.
4	Raise copier cover and inspect the glass for dirt, scratches, and smudges.
5	Inspect readout LEDs for copier status: • if jammed, open door, inspect, and clear paper path, • replenish toner if needed, and • retrieve jammed documents from rollers.
6	Select options.
7	Insert master into feed tray.
8	Push copy button.
9	Remove master and copy.

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Copier maintenance

When a copier needs more toner or a new ribbon, the copies will appear progressively lighter in tone. They will be uneven in resolution and color balance.

To change toner or ribbon, follow this table:

Step	Action
1	Follow instructions: • posted on the machine interior, • in the operating manual, and • call key operator.
2	Handle toner/ribbon with care.
3	Open cover door to copier.
4	Remove and discard old toner canister or ribbon cartridge.
5	Open new canister and replace.
6	Close cover door.
7	Run test copy.

Diazo Machines

Introduction

Diazo machines have been around a long time. Navy shops still have these workhorses tucked away in reproduction rooms. Although diminished in importance, these machines continue to produce good quality, cost effective, correctable reproductions on paper, Mylar, vellum, and acetate foils.

General types

Two general systems are in use in diazo process machines. The first is a continuous gravity feed ammonia system. These machines drop ammonia at the rate of 50 to 60 drops per minute into a tray where heater rods vaporize the ammonia into developing fumes. The second type of diazo system is the anhydrous ammonia system that mixes ammonia vapor with distilled water.

Figure 4-2 illustrates ammonia vapor production in a gravity feed and an anhydrous system.

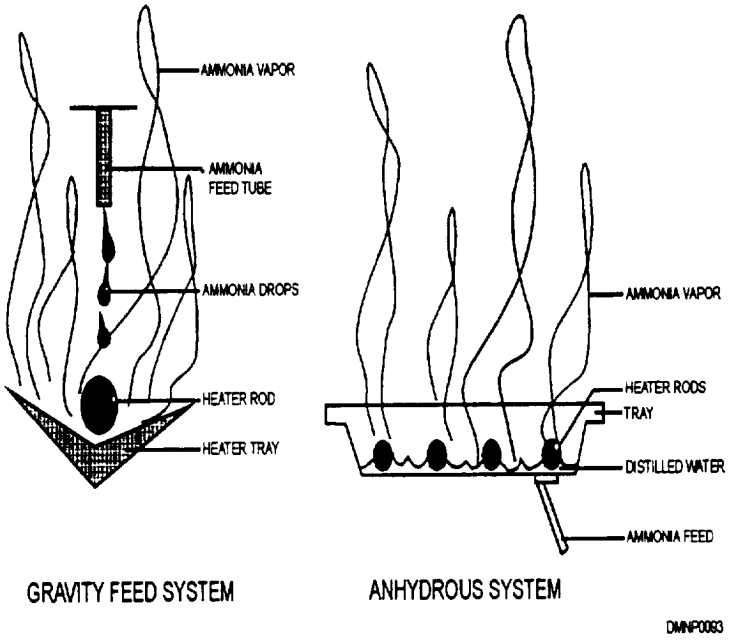

Figure 4-2. —Ammonia vapor production.

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Major sections

A diazo machine has four major components. These components are a printing section, a developing section, a cooling system, and an exhaust system.

PRINTING SECTION: The printing section contains a light source, the reflector assembly, a printing cylinder, and the feed belts.

Figure 4-3 shows the configuration of the printing section.

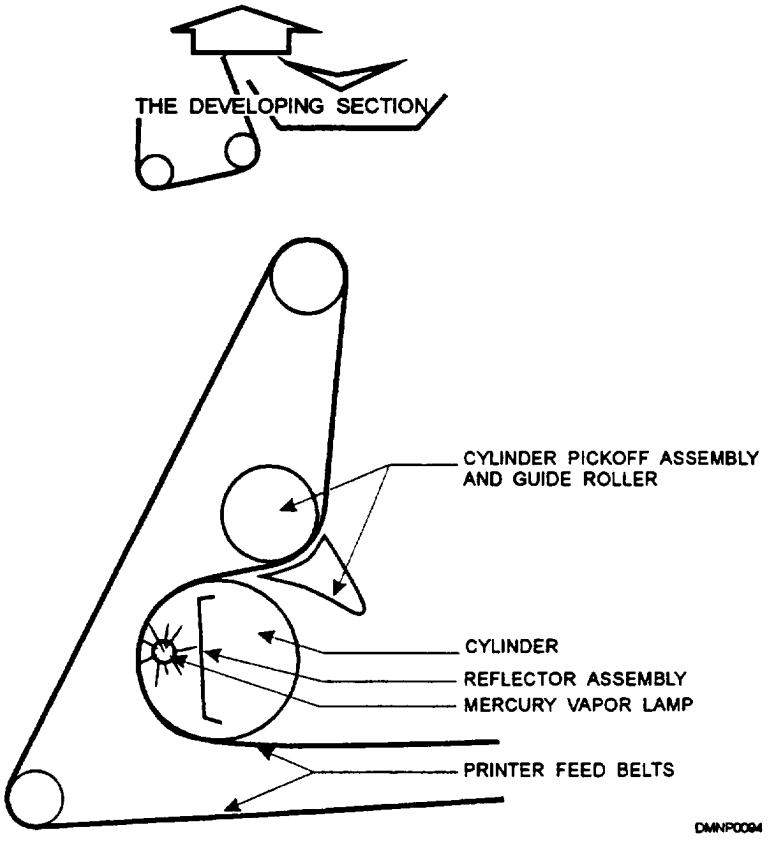

Figure 4-3. —The printing section.

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Major sections (Continued)

DEVELOPING SECTION: The developing section houses the stainless steel developing tank and the heater rods.

Figure 4-4 shows the developing section.

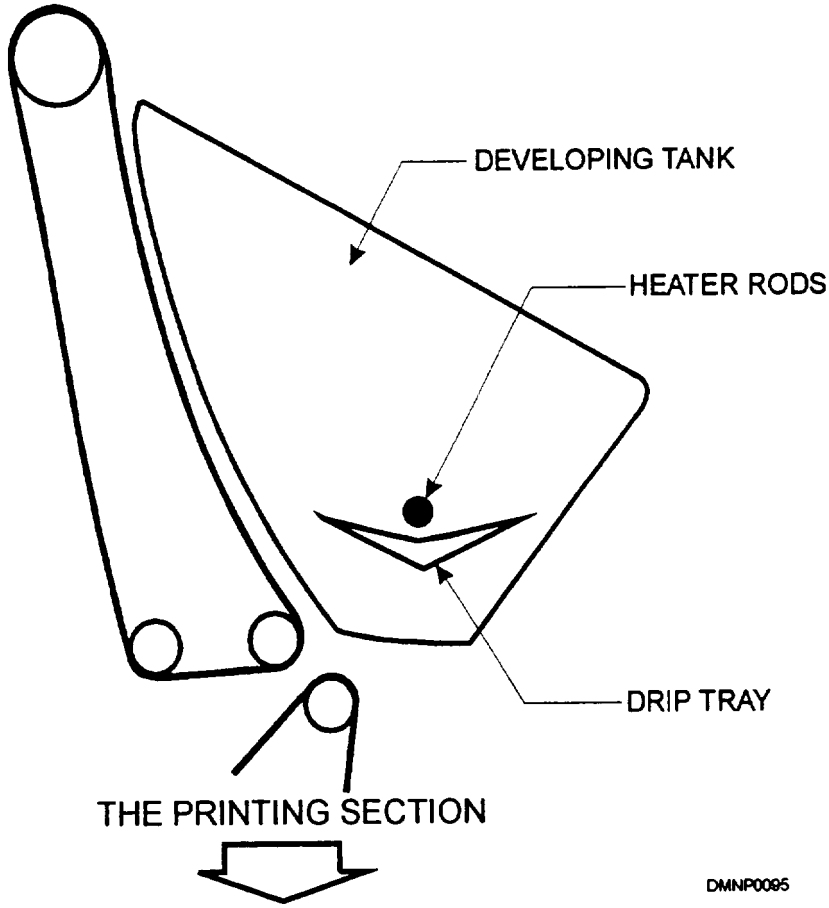

Figure 4-4. —The developing section.

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Major sections (Continued)

COOLING and EXHAUST SECTIONS: The cooling section contains the blower and timer that cool the heating rods and drip trays. The exhaust section, monitored by the blower and timer, expels fumes through exterior ducts and deposits residue into the residue collection bottle in the base of the machine.

Figure 4-5 illustrates the basic ammonia flow system.

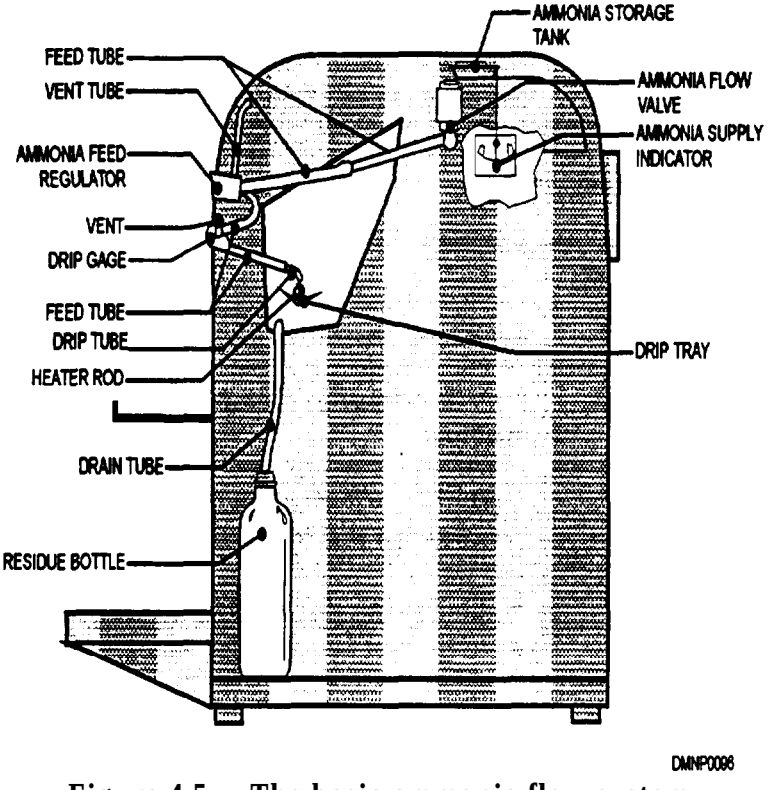

Figure 4-5. —The basic ammonia flow system.

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Start-up and shut-down operations

The following tables give start-up and shutdown procedures and operator checks for standard diazo-type machines:

start-up

Step	Action
1	Make sure the drain tube is inserted into residue bottle.
2	Check ammonia storage tank; refill if needed.
3	Turn machine on.
4	Adjust ammonia flow to 50/60 drops per minute.
5	Run machine 20 minutes or until machine reaches an operating temperature of 180 to 210 degrees.

Shut-down

Step	Action
1	Set blower motor to 20 minutes and turn off ammonia flow.
2	Feed a sheet of porous paper as wide as machine throat through machine.
3	Turn off machine to stop paper when wrapped around cylinder and between the sealing sleeve and developing tank: • to prevent sleeve from sticking and • to protect belt from residual heat.

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Diazo Machines, Continued

Maintenance

Diazo machines fail to perform or become dangerous to operate without regular maintenance. Daily maintenance consists of emptying residue bottles every 8 hours, replenishing the ammonia supply, cleaning the outside of the glass cylinder, and cleaning the feedboard, receiving tray, and print tray of debris and paper scraps. Weekly maintenance is cleaning the inside of the cylinder and wiping the lamp assembly. Lubricating all bearings using a No. 10 motor oil and cleaning the suction holes is done monthly. Remove, clean, and dust all hoses annually.

Specific safety precautions

In addition to precautions ascribed to electrically powered machinery, diazo-type machines require the following specific safety precautions:

- store ammonia in shatterproof bottles,
- protect bottles in storage by securing them in place,
- handle ammonia bottles carefully to prevent:
  - blindness and bums to personnel,
  - stripping finishes off of surfaces, and
  - never turn ammonia flow completely off while machine is running.

Diazo sensitive materials

Diazo sensitive materials are papers, acetate, and lightweight cardstock coated with diazo salts and azo dyestuff emulsion. This emulsion is sensitive to light. Exposure to light through a transparent or translucent master desensitizes areas not protected by the opaque image of the master. After development in ammonia vapor, desensitized areas appear clear and protected areas appear as the image. Paper comes in different weights and as standard line, continuous tone, and sepia line stock. Drafting film comes as a blueline or sepia image stock. Foils or acetates, used for transparencies, come in normal intensity colors and pastels, black or color on color backgrounds, and in a variety of densities, weights, and sizes. Cardweight stock is available with a metallic shine. All diazo materials fade in time and exposure to daylight accelerates fading. Because developed images retain residual ammonia vapor fumes that permeate and deteriorate paper, do not store them with other file images, particularly photographs.

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Diazo material storage

Diazo material is stored on a first in/first out basis. Before storing, mark the contents of the package with the date received and package contents. Diazo materials are light and temperature sensitive. Store them in a cool, dark, dry location.

Diazo masters

Master artwork for diazo reproduction are dense, opaque images on a transparent or translucent base of paper or acetate. A commercial product, called "transparentizer," lessens the opacity of lightweight translucent papers. When creating the master, use shading sheets judiciously; the heat of the mercury-vapor lamp in the diazo machine can melt the adhesive. It will also melt a master created using an image from a thermal copier. Place registration marks outside of the image area in multifoil transparencies.

Diazo exposure

To expose diazo material, place the sensitized material on the feedboard emulsion side up and place the master on the material emulsion side down. Better images result from emulsion to emulsion contact. Webb belts will slowly feed the combination through the machine. There is a slight dimensional instability in diazo material that occurs as the cylinder rotates the diazo material from the heat of exposure to the dampness of the development process. The master and the material will automatically separate before the material enters the development area.

Figure 4-6 illustrates placing a master on diazo material.

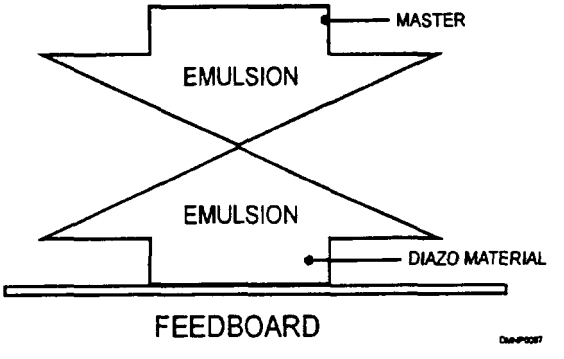

Figure 4-6. —Combining a master with diazo material to feed into the machine.

Phototypesetters

Introduction

Phototypesetting machines expose photosensitive paper or film to a light image of each character set, either electromechanically or by digitation (cathode-ray tube (CRT)). The two primary components of a phototypesetter are a keyboard and a processor. Because of rapidly changing technology, this section provides only a brief overview of phototypesetting systems.

General maintenance

Before covering phototypesetting theory and equipment, let's cover basic maintenance procedures for the equipment and the handling of the film/paper.

- Avoid excessive handling of the film/paper to minimize scraping the sensitized surface, kinking, and increasing static discharge.
- Check the internal mechanism of the processor for:
  - obstructions in the film/paper path and
  - the solution level of the processor tanks.
- Rinse the roller assembly and trays daily with warm water and loosen crystallized chemical deposits with a soft brush.
- Clean optical surfaces with a lint-free cloth or chamois and mirrored surfaces with a camel hair brush.
- Refer to the owner's manual for specific maintenance periodicities,

General adjustments

With most typesetting equipment, it is possible to adjust type size, type font, line length, letter density, word, line, and lettering spacing, type position, and leading. Some typesetters are further divided by their ability to produce display type or body type. Direct keyboard, magnetic storage on tape or disk, and a retrieval system through optical character recognition (OCR) are available on newer machines. Refer to your owner's manual for the full range of operator adjustments.

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Phototypesetters, Continued

Typesetter generations

The term *generation* classifies significant advancements in phototypesetter technology. The first-generation phototypesetters closely resembled machines used to cast hot type. Second-generation phototypesetters set type by photographic projection through a font. Third-generation machines reproduce letters on the face of a cathode-ray tube (CRT) and fourth-generation equipment uses raster scan technology and fiber optics. Third-generation phototypesetters still exist in Navy Graphics shops.

Third-generation typesetters

Third-generation phototypesetters use cathode-ray tube technology. There are two basic categories of CRT typesetters. The first category, electromechanical typesetters, scans a photographic master stored on grids and strikes an image onto the face of a cathode-ray tube. This image then passes through a lens to photographic film or paper. A letter is rescanned each time it is used. This process is referred to as "on the fly." The second category typesetter stores the font as a digital representation; a letter is scanned only once and enters the machines memory for subsequent use.

Electromechanical typesetters

Electromechanical typesetters may produce display or body type. They are hand-operated by direct keystrokes. Newer machines may have magnetic disk or tape memory and/or OCR scanning capabilities. Different type styles and sizes are available for enlargement, reduction, or same-size reproduction. The typesetter scans a photographic master each time a letter is used and transfers the image on the fly to the face of a CRT screen or photosensitive film/paper.

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Digitized typesetters

Digitized typesetters set type with greater speed and detail than electromechanical machines. An electronic beam draws on the face of the CRT tube in random fashion. Image refresh is greater than 30 times per second at 2,600 lines per inch (LPI).

Figure 4-7 shows character imagery in digital phototypesetting.

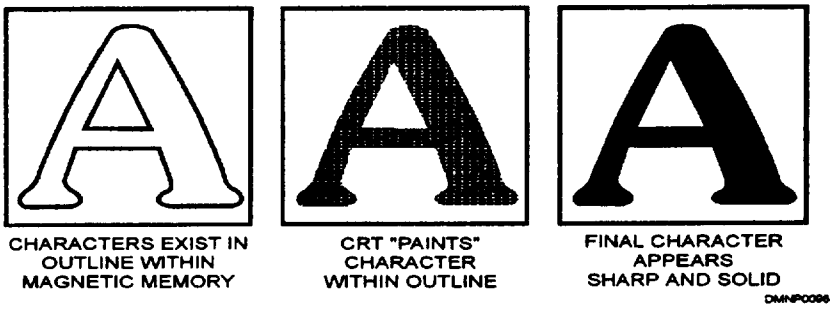

Figure 4-7. —Digitized phototypesetting.

LASER

Light amplification by simulated emission of radiation (LASER) phototypesetters raster scan an image in a very tight pattern with a narrow beam of light or energy. This allows for precise control of the image area. Characters, art, and halftones are generated picture element (PIXEL) by pixel at 700 to 1,500 LPI. Point size ranges from 5 to 246 points. Note that a point size and a pixel are not the same. Notice also that a halftone and a pixel are not the same. A halftone is comprised of pixels and how many depends on the resolution of the screen and the percentage of the halftone pattern desired. This type of typesetter and processor is also known as a raster image processor (RIP).

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Phototypesetter processors

The developing unit of a typesetter develops the image after transfer to photosensitive film or paper. The machine is self-developing. The two types of development processes are the stabilization process and the photographic process.

STABILIZATION PROCESS: The stabilization process is a nonpermanent process that uses an activating solution to develop the image and a chemical stabilizer to halt the development.

PHOTOGRAPHIC PROCESS: The photographic process is a permanent process much like standard photographic processing. It uses a chemical developer to mature the image, a fixer to stop development of the image, and a water wash to remove chemical residue from the developed image.

Figure 4-8 illustrates the two types of phototypesetting processor systems.

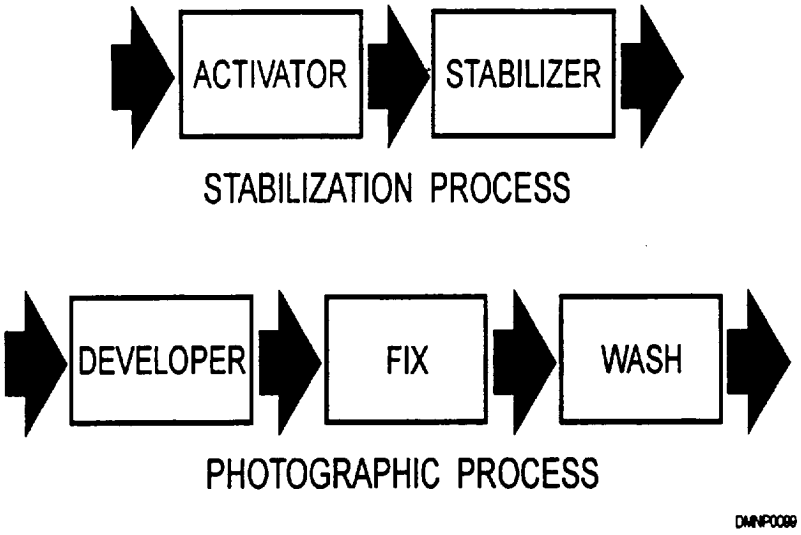

Figure 4-8. —Two basic types of phototypesetting processes.

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Chemistry exhaustion

Change the chemistry in the processor often to keep developed images crisp and dense. As the chemistry oxidizes or expires, images become weak, thin, and grey. Streaked images also indicate a need to replenish the processor with fresh chemistry.

Typical work flow

Your initial interface with the typesetter is at the keyboard where all parameters are coded into the machine and the stroking of the image begins. This keyboard connects to the processor, sometimes through a memory storage system, and the processor develops the image. Carefully proofread all data. Assemble the text with the artwork and conduct a final proofreading.

Figure 4-9 shows a typical work flow pattern for a job that requires typesetting.

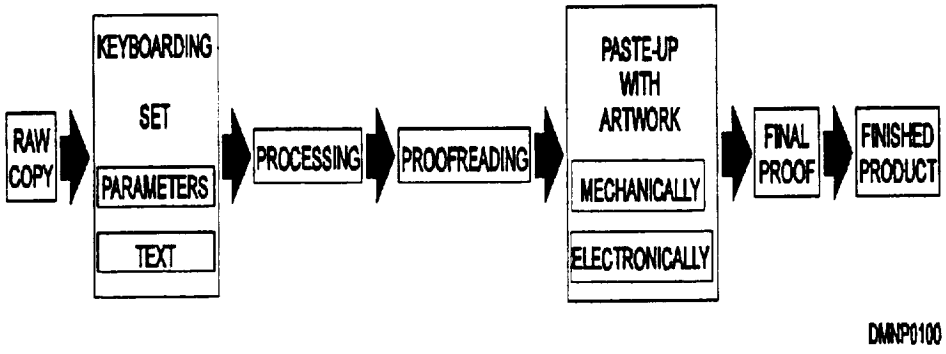

Figure 4-9. —The phototypesetting process.

Pressure Process Lettering Machines

Introduction

A pressure process lettering device impresses letter fonts against a tape of paper or acetate film transferring a carbon image of a letter or symbol and with some machines, actually cutting the letter or symbol into the tape. This paper or acetate film is stripped into place on artwork or a paste-up. A number of manufacturers produce them with options that include keyboards, memory storage, letter distortion, and color.

Manual machines - carbon image

Manual pressure process lettering machines are simple in theory and use. They consist of a basic machine with a print button, cutter lever, and letter disks or fonts.

To use a manual machine, follow this table:

Step	Action
1	Plug the machine into power source and turn machine on.
2	Select a disk or font of desired style.
3	Adjust machine with parameters indicated on disk or font.
4	Insert disk or font into machine.
5	Rotate disk until the desired letter appears in the print window.
6	Press PRINT button.
7	Continue process until word or phrase is complete.
8	Advance leader and draw cutter lever up sharply to cut tape.
9	Turn off machine; return disk or font to storage.

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Pressure Process Lettering Machines, Continued

Automatic machines - carbon image

Automatic pressure process lettering machines approach the sophistication of phototypesetters, but they are less complicated to use. These machines have a keyboard, limited memory storage, and a monitor screen to view the work in progress.

To use an automatic machine, follow this table:

Step	Action
1	Plug into power source and turn machine on.
2	Select desired font and insert into font port.
3	Adjust spacing and height for selected font.
4	Keystroke text into memory and proofread from screen.
5	Press PRINT button.
6	Press ADVANCE button to advance tape and clear cutter.
7	Press CUT button to cut tape.
8	Press CLEAR to erase image from screen and memory.
9	Turn off machine and restore fonts.

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Pressure Process Lettering Machines, Continued

Manual machines - cutout image

Some pressure process lettering machines cut letters or symbols from paper and vinyl tape. Each letter/symbol is an individual font template. The template is inserted into a channel with the cutting edge facing the tape. A rotating drum applies sufficient amount of pressure to cut through the paper or vinyl as the tape and template press together. A manual machine has a hand-operated crank, letterspacing adjustment, letter height adjustment, pressure adjustment, tape holder, and font templates.

To use a manual machine, follow this table:

Step	Action
1	Insert tape onto tape roll holder in back of machine.
2	Select font plates.
3	Set letterspacing as indicated on font plate.
4	Set letter height adjustment as indicated on font plate.
5	Set pressure adjustment as indicated on font plate.
6	Insert font plate of desired letter into channel at the top of the machine.
7	Make certain the ridges on the font plate face the back toward tape.
8	Rotate hand crank one complete revolution.
9	Remove font plate from machine and replace in order in carrier.
10	Continue process until word or phrase is complete.

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Pressure Process Lettering Machines, Continued

Automatic machines - cutout image

Automatic machines for cutout letters/symbols are exactly like their manual counterpart except for the cutter at the back of the machine. On a manual machine, the tape is tom by hand across a serrated edge. On an automatic machine, the tape is cut by pushing a button that activates a guillotine-type cutter near the tape holder. Directions for use of an automatic machine are identical to those for a manual machine.

Tapes - carbon

Carbon image tapes are available in combinations of paper or vinyl, opaque or transparent, adhesive or nonadhesive backed, white background, colored background, white letters, and colored letters. Carbon image tape has a soft surface that scratches easily. The surface of some carbon image tapes has a low tack surface that requires sealing with a fixative. When you use a carbon image, adhesive-backed tape in artwork that requires exposure to a heat-producing process, check the tape periodically during that process for adhesive seeping. Seepage gums up a diazo drum or copyboard and ruins the artwork. If a tape has lost adhesiveness, it will jar out of position on the artwork and misalign.

Tapes - cutout

Paper and vinyl tape, used in pressure cutout systems, are available in eight colors and are adhesive-backed. Several layers make up the tape, and these layers facilitate an easy application of the cutout letter to the artwork. Peel a comer of the carrier acetate away from the color tape. Turn the tape, adhesive side up, and place it on a work surface. At a low angle to the tape, peel the backing wax paper and the excess color tape away from the carrier tape carefully. Watch the cutout letters/symbols to make sure they remain on the carrier acetate. Throw away the wax paper and excess tape. Place the carrier tape, which now supports only the desired tape letters, over the artwork and press gently over the letters/symbols. Peel away the carrier tape slowly and at a low angle. The letters/symbols will remain. Throw away the carrier acetate.

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Tapes - cutout (Continued)

Figure 4-10 shows the different tape layers and a low angle of peel.

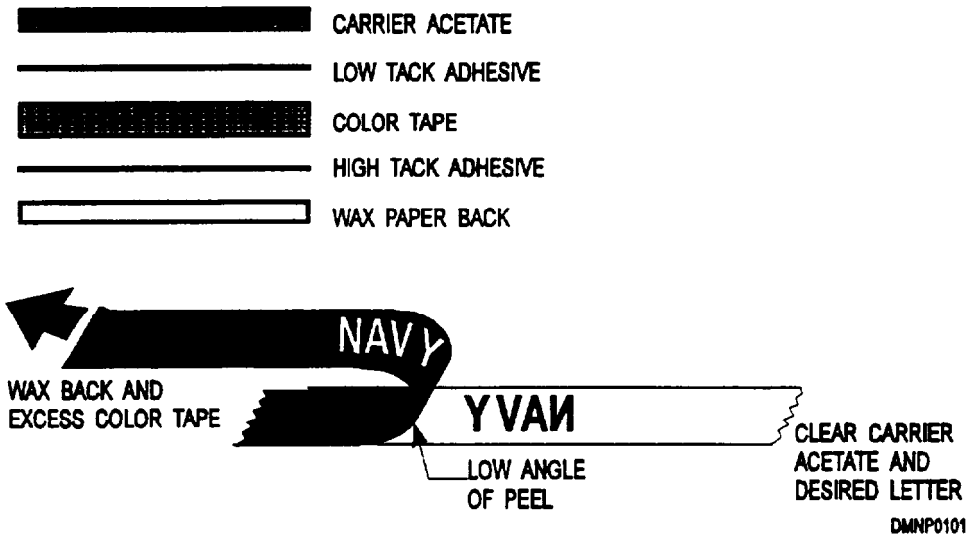

Figure 4-10. —Tape layers.

Special Applications Graphics Machines

Introduction

There are a number of graphics machines that have special purposes. Two machines that you may encounter in the fleet are the engraver and a computerized graphics machine.

Engravers

An engraver routes letters and images below the surface of metals and plastics. Personnel name tags, doorplates, desk plates, and shipboard signage are all examples of engraved products. Engraving is also done on plaques and trophies and shadow boxes. Engravers work on the same principle as a pantograph; that is, a parallelogram with repositionable tracer and drawing points.

Figure 4-11 shows the similarities between a pantograph and an engraving rig .

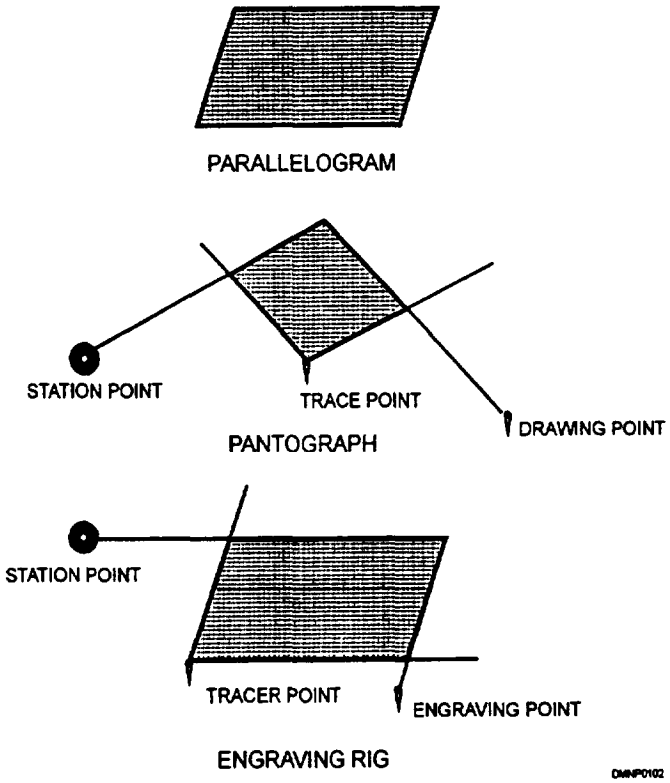

Figure 4-11.—Similarities in operation.

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Engraver features

Manual engravers may be hand-driven or motorized. Newer, automated engravers have keyboards, a memory system, and an editing screen. Engravers enlarge, reduce, or create the same-size letters by tracing fonts secured in a galley and redrawing that image into plastic or metal. Engravers have a motor, pulleys, a galley tray, a tracing point, tracing arms, and jigs to hold round or flat objects. Templates are slid into a galley tray and secured by thumbscrews. Templates are available in many styles and are made of brass. The engraver cuts the letter/symbol outline into plastic or metal, using a cutter. Cutters are carbide steel for cutting plastic and diamond-tipped for engraving metal. Use the motor with the carbide cutters. The diamond-tipped cutters require only hand pressure to cut metal.

Figure 4-12 shows different cutter points.

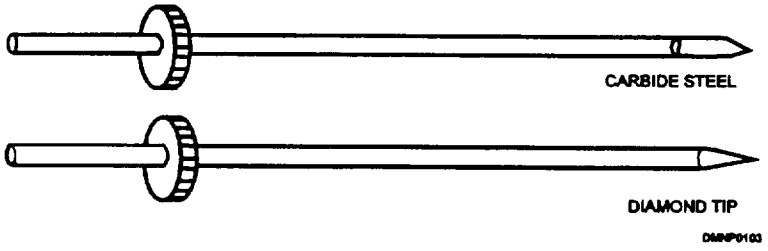

Figure 4-12. —Cutter profiles.

General care

Inspect the engraving machine before using it. Like other electrically powered tools, inspect the cords and wiring for wear. Examine the pulleys and belts for dryness and stretching. Use sharp cutters of the correct depth in the machine.

General maintenance

Clean debris from all surfaces. Remove the jigs to brush away debris under the galley. Remove the thumbscrews and brush debris from the galley trays. Brush away debris from under the jigs and surrounding areas. Engraving residue is similar to sawdust; it gets everywhere. Maintain sharp cutter points and clean, sharp templates. Do not over tighten thumbscrew settings.

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Use

Select a cutter for engraving based on the material being engraved and the desired effect. Diamond-tipped metal cutters do not require the use of a motor. They cut a fine line into a metal surface. A wider line is possible with a carbide cutter, but that requires the motor to rotate the cutter head. Plastic is cut using the carbide steel cutter points and motor only. Carbide cutters offer differing widths.

To use an engraver, follow this table:

Step	Action
1	Inspect the condition of the machine.
2	Select cutter and insert into the machine.
3	Set correct depth for the cutter and tighten setscrew.
4	Select template style.
5	Insert template pieces into galley.
6	Center word or phrases in galley and finger-tighten thumbscrews.
7	Adjust letter height and letter slant.
8	Center item for engraving into holding jigs and tighten jigs.
9	Place tracer point into groove on template.
10	Turn motor on.
11	Apply pressure with the left hand to the tracer point.
12	Simultaneously apply pressure with the right hand to the cutter.
13	Trace letter until engraved image is distinct and uniform in width.
14	Continue until word or phrase is complete.
15	Turn motor off; replace templates into storage unit.
16	Remove item from jigs; clean area of debris.

Continued on next page

Special Applications Graphics Machines, Continued

Computerized graphic machines

There are computerized graphic machines that draw, pounce, and cut letters and graphics with the latest advances in digital typesetting. These systems use paper, vellum, vinyl, rubylith masking film, and application tape. The tools of these machines change from ball-point pens, to pounce wheels, and to knife blades. Some of these machines are self-contained units and others hook up to computer systems. Many commercial sign shops use this type of graphics device to reduce production time and enhance quality. Few of these machines are in Navy shops, but you should know of their existence.

Cameras

Introduction

Cameras, in one form or another, have always been one of a DM's tools. A DM either uses a photographic process in the creation of artwork or prepares artwork for photographic reproduction. Knowledge of camera types and the basic functions of camera parts are essential.

General maintenance

Cameras may be process cameras found in large studio settings or hand-held 35mm cameras and copy cameras. Maintenance is similar for all the various types of cameras.

PROCESS CAMERAS: Process cameras usually have an electrical power source to drive timers, settings, and lights.

- Inspect electrical cords for fraying or bare wire.
- Clean optical surfaces with a lint-free cloth or chamois.
- Clean mirrored surfaces with a camel hair brush.
- Keep bellows, copyboard, and film plane free of debris and lint.
- Lightly oil rotating handwheels, cranks, and worm gears.

35MM and COPY CAMERAS: Small cameras like 35mm and copy cameras rely on a battery for power.

- Check the battery compartment for battery status:
  - is the battery present,
  - is the battery fresh, and
  - is the battery swollen or leaking.
- Clean optical surfaces with a lint-free cloth or chamois.
- Clean mirrored surfaces with a camel hair brush.
- Wipe down camera body with a lint-free cloth or chamois.
- Dust inside film back with a camera hair brush.

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Process cameras

Process cameras are large studio-type cameras. They may be horizontal or vertical in construction. Horizontal process cameras divide into darkroom cameras and gallery cameras. Darkroom cameras have the back or the film plane built into a wall. On the other side of the wall is the darkroom. Gallery cameras are free standing units. Vertical process cameras take up less space. Both horizontal and vertical process cameras have fully automated exposure control.

Figure 4-13 shows various types of process cameras.

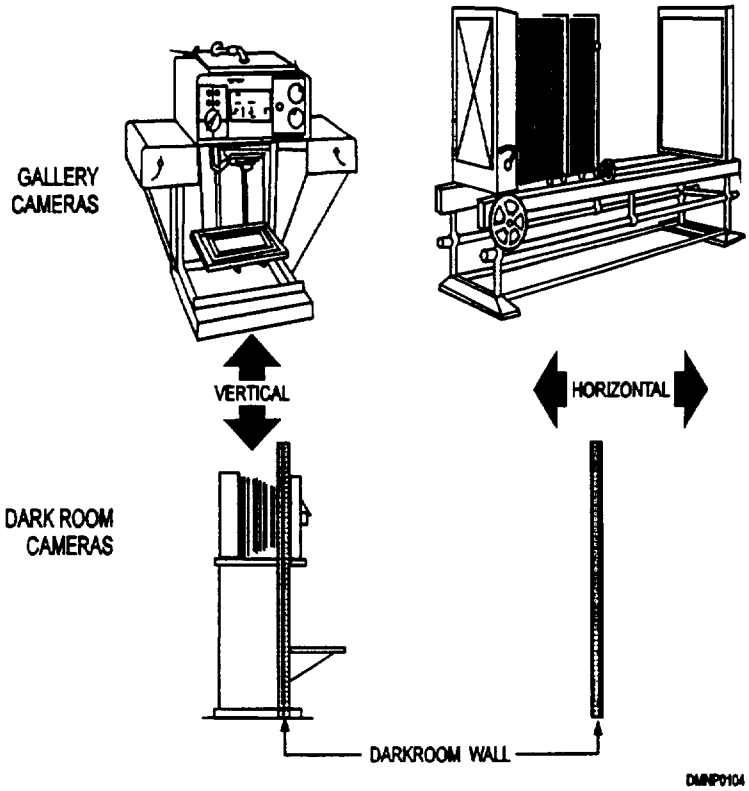

Figure 4-13. —Format types of process cameras.

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Camera components

Cameras consist of seven basic components on three parallel planes. Misadjustment of any component part of a process camera affects the reproduced image in size, clarity, or density. The three parallel planes of a copy camera are the copy plane, the lens plane, and the focal plane. Consult the manufacturer's operating instructions for precise operator adjustments.

COPY PLANE: The copy plane is a glass copyboard that holds the original copy in place. The most common size is 18 by 24 inches with gridded reference lines to help align the original copy. Vacuum pressure creates suction to flatten the copy during a shoot. The copy plane may move on a track for proportional reductions or enlargements.

LENS PLANE: The lens plane holds the lens in position. Some lens planes have interchangeable lenses. The lens plane moves along a track for proportional reductions or enlargements.

FILM or FOCAL PLANE: The film plane holds the film in place in the back of the camera. The film plane may also have a filter attachment for halftone or color separation work. Without film, the ground glass of the focal plane allows for fine focusing an image.

SCALES: Most cameras reduce to 50 percent and enlarge to 300 percent or a range in between.

FOCUSING CONTROL: Handwheels or cranks rotate to focus an image. Newer machines have automated push-button focusing.

BELLOWS: Bellows are the accordion folded segment between the lens and the film plane. Bellows maintain lighttight integrity during enlargements and reductions.

EXPOSURE CONTROL: Once the copy plane, lens plane, and focal plane are positioned correctly, the camera scales recommend settings for the f/stops and/or the shutter speed. Some cameras are set manually and other cameras are automated. Automated cameras are aperture priority cameras where the operator sets the shutter speed and the camera sets the aperture opening. Shutter priority is when the operator sets the shutter speed and the camera selects the aperture. Little figuring is done by the operator in either case.

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Camera components (Continued)

Figure 4-14 shows a basic process camera with the primary components identified.

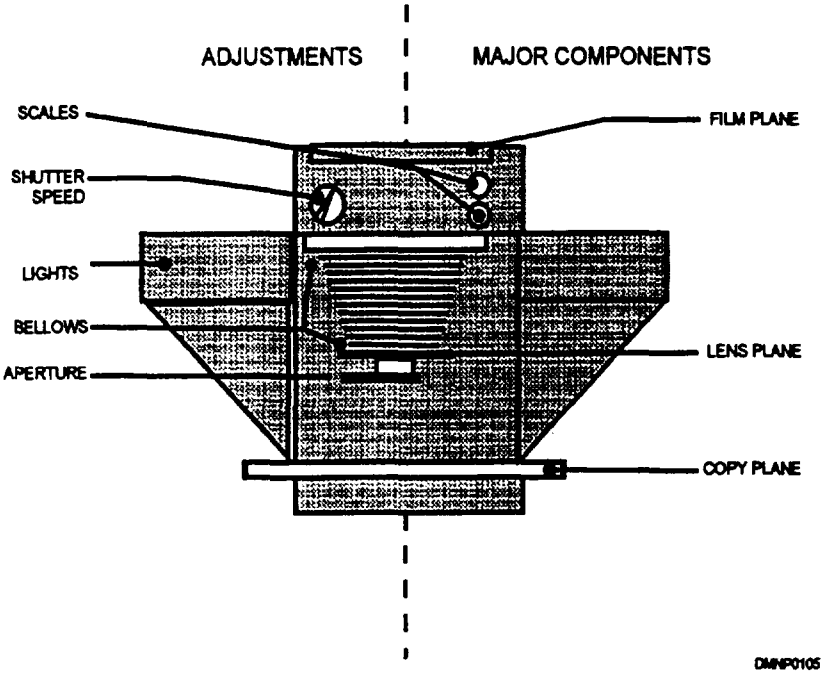

Figure 4-14. —Process camera nomenclature.

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Lighting

You can use almost any type of light for copy work, provided the intensity of the light is sufficient to prevent excessively long exposures. Another principal requirement of the light source is that it produces a light with a color temperature suitable for the type of film used. Use normal room light to focus the image on the focal plane. Use copy lights on high to expose the film.

Types of lights

Lights maybe part of the camera, as are lamp housing units and lights in the copyboard, or they may be separate units. Lighted copyboards illuminate copy from underneath. This allows greater control of negative density. It is also superior for backlighting film positives and transparencies.

Figure 4-15 shows different light configurations.

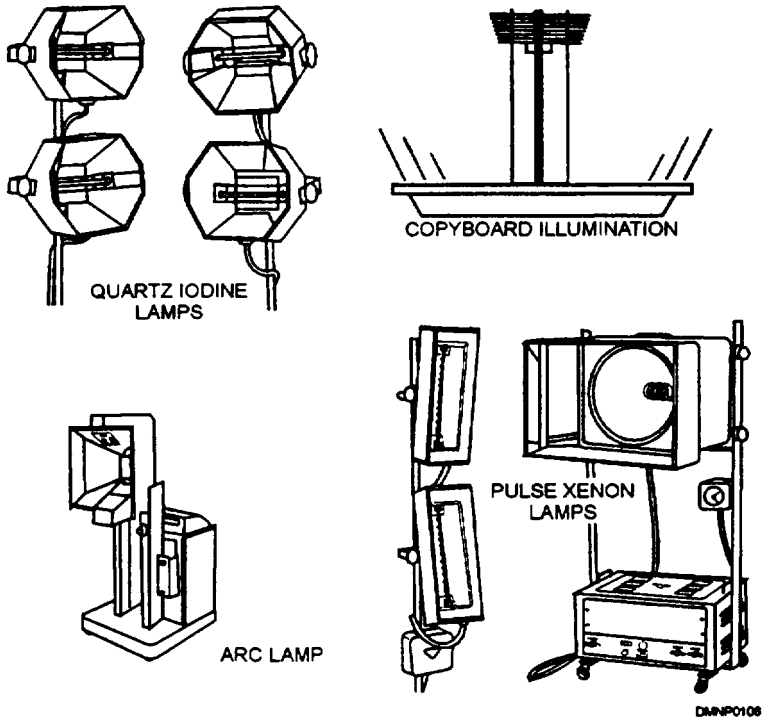

Figure 4-15. —Light configurations.

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Light temperature

Light temperature becomes critical when reproducing color images and an imbalance light source will skew tonal values in black-and-white reproduction. The most common lamps in Navy Graphics shops are the tungsten lamp, fluorescent lamp, and quartz iodine lamp variations.

TUNGSTEN LAMPS: Tungsten lamps are excellent for use in black-and-white reproduction. Tungsten lamps are available as 3200 degrees Kelvin (K) and 3400 degrees Kelvin. Lamps rated 3400 degrees K are used less because they have a short life of 4 to 6 hours.

FLUORESCENT LAMPS: Use fluorescent lamps when the original has a textured or uneven surface and little reduction or enlargement. Even illumination of a smooth-surfaced original is difficult to obtain. When you use fluorescent lamps, arrange the tubes in a square pattern parallel to the edges of the copyboard.

QUARTZ IODINE LAMPS: Quartz iodine lamps produce a very intense light particularly suited to general copy work. They maintain a fairly constant color temperature throughout their life.

Reflectors

Reflectors evenly distribute light over the surface of an original, eliminating hot spots. Reflectors also funnel more light toward the original that shortens exposure times. Certain types of lights have built-in reflectors. When you use a lamp with a built-in reflector, also use a lens hood to shade the lens from glare and stray light.

Lamp replacement

Keep all lamps clean and free of dust and finger smudges. Handle lamps carefully. Replace all lamps in the system simultaneously. As lamps age, temperature variations occur. Failure to replace all lamps creates an imbalance in temperature and intensity of illumination.

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35mm cameras

The two types of 35mm cameras are the rangefinder camera and the single lens reflex (SLR) camera. This classification indicates the way the image projects on the film plane for focusing. The film size for these cameras is 35mm film, hence the name.

RANGEFINDER CAMERAS: Focus an image on the film or focal plane of a rangefinder camera by aligning one image over another until they coincide. The image enters the lens and diverts to the focal plane from a mirrored surface. The distance between the viewing lens and the lens through which the exposure is made is called parallax. Parallax is automatically corrected in a rangefinder camera.

Figure 4-16 shows how an image passes through a rangefinder.

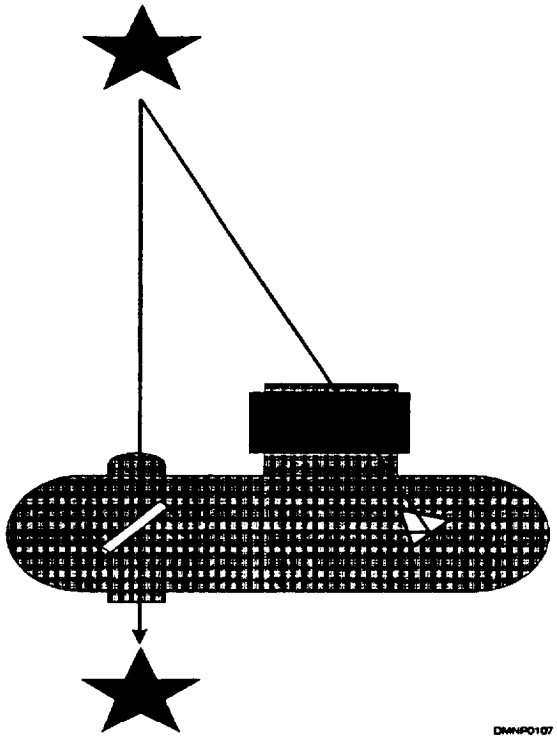

Figure 4-16. —View through a rangefinder.

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35mm cameras (Continued)

In a single lens reflex (SLR) camera, the image enters the lens and strikes a mirror. This mirror deflects the image onto a ground glass for focusing. The mirror flips out of the way during exposure; therefore, the viewing lens is the same lens that records the image.

Figure 4-17 shows how an image passes through an SLR.

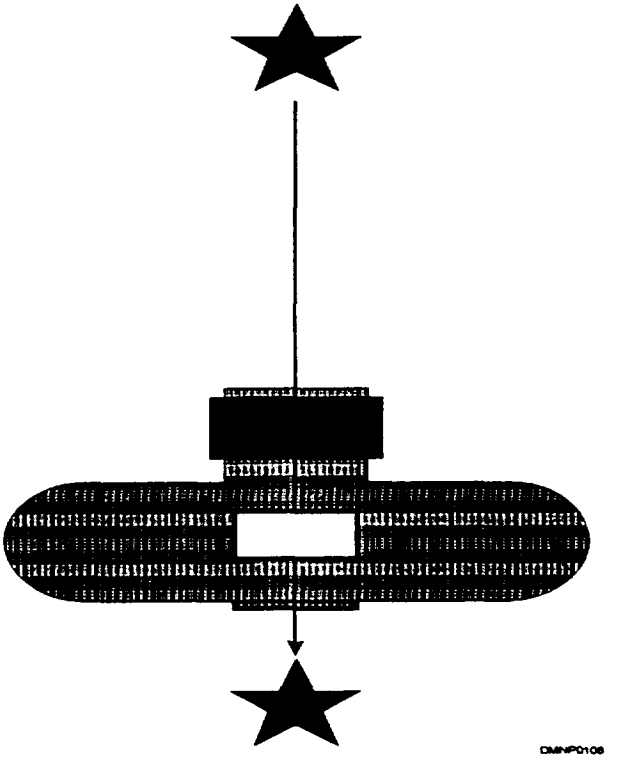

Figure 4-17. —View through a SLR.

Camera components

Camera components are similar to those of a process camera. There is a film or focal plane, a lens, and the object or a copyboard. Shutter speed settings and apertures or f/stops are adjustable. There is also a setting to indicate the film speed to the automatic sensors in the camera. Lenses are interchangeable on 35mm cameras.

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Lenses

Camera lenses have different ranges that make some lenses more suited to copy work than others. Range refers to focal length or the distance between the lens plane and the focal plane. Lens range may be long, short, standard, variable, or macro. The speed of a lens increases as focal length decreases.

LONG RANGE: Long-range lenses are telephoto lenses. Use these lenses to draw an image closer. Ideal for action or sports photography, they require more light and faster film than standard lenses.

SHORT RANGE: Short-range lenses are fast lenses with a wide angle of view. They are excellent for photographing large expanses in limited space and panoramic views.

STANDARD RANGE: Standard-range lenses most closely record the image as seen by the human eye. Distortion is relatively negligible.

VARIABLE RANGE: Variable-range lenses are zoom lenses or lenses in which the focal length changes at the option of the photographer.

MACRO RANGE: Macro-range lenses are ideal for copy work, particularly if the item being copied is small. This lens is slower in speed than standard lenses. Available as 50mm and 100mm macros, they also perform well as a general-purpose lens in routine shoots.

Figure 4-18 shows differences between lens ranges.

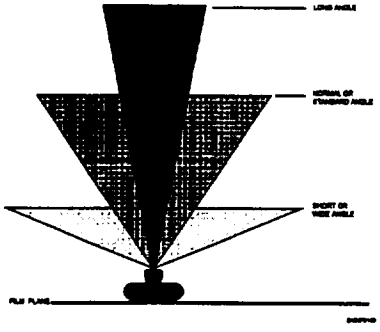

Figure 4-18. —Lens ranges.

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Aperture

An aperture is an opening in a lens through which light can pass. Apertures are set at standardized intervals, referred to as f/stops. F/stops help control image sharpness by partially correcting for lens aberrations and defining depth of field. Changing aperture settings changes the amount of light allowed to strike the film. The greater the numerical value of the f/stop, the less light enters the lens. Each increment divides the light by half. If your camera or hand-held meter is not working or you find yourself in a situation where you haven't the time to calculate an f/stop, use the f/16 rule; that is, set the f/stop to f/16 and the shutter speed to the film speed, or as close to the ISO that the shutter speed adjustment will allow.

Figure 4-19 shows standard f/stop increments.

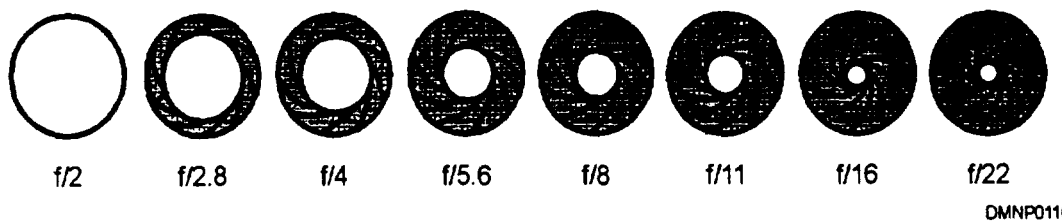

Figure 4-19. —Standard f/stop increments.

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Shutter speed

Shutter speed is the length of time light can expose the film. A camera may have a leaf-type shutter or a focal-plane shutter. The shutter speed is set in standardized increments. Increasing the shutter speed incrementally lessens exposure time by half. At the "T" setting, the shutter opens the frost time you press the shutter release button and closes the second time you press the release button. At the"B" setting, the shutter remains open as long as you depress the shutter release button.

Figure 4-20 shows standard shutter speed ratios,

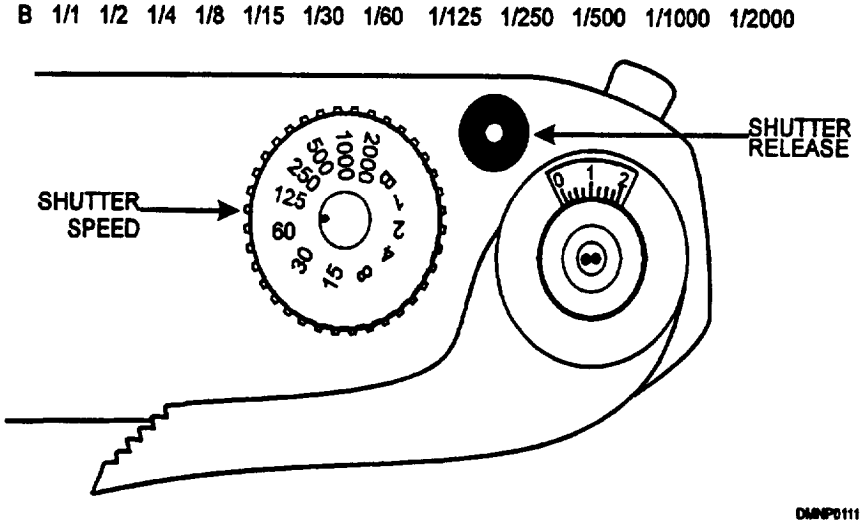

Figure 4-20. -Shutter speed increments.

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Cameras, Continued

Film speed

Film speed appears on every roll of film and is an industry-rated standard. The standard is set by the International Standards Organization (ISO). Film speed, sometimes referred to as film sensitivity, indicates the sensitivity of the film emulsion to record latent images of light. Film speed may be fast or slow. Selection of a film speed requires a knowledge of film characteristics, lighting situations, and potential compromises.

FAST FILM: Film considered "fast" is film that requires less light for exposure. These are the low-light film speeds of ISO 400 and higher. Image resolution is good in small prints; however, pronounced graininess appears in enlargements. Some of the very fast films, ISO 1000 and faster, need very little light and an extremely short exposure time, making them more desirable for dimly lit auditoriums and difficult to handle in daylight situations.

SLOW FILM: Slow film requires more light or longer exposure times to record an image. Slow films, such as ISO 25, have very fine grain that remains fine even in enlargements. These films are ideal for a controlled studio atmosphere.

Slide duplicators

Sometimes a photo lab is not available to produce duplicates of slides or transparencies. The DM is able to duplicate slides using a slide duplicator that attaches to the front of a camera body much as a lens does. The duplication process allows the DM an opportunity to correct minor exposure errors and perform limited cropping of the original slide. The light meter in the camera can meter exposure. Transparencies, placed on a light table or the illuminated copyboard of a process camera, can be re-photographed with a 35mm camera and slide film.

Summary

Review

This chapter covers general safety precautions for and maintenance procedures of the basic equipment used to produce a first-generation copy from an original. Equipment and procedures are intentionally generic for copiers, diazo machines, phototypesetters, lettering machines, and cameras since different equipment is in every Navy shop. Familiarize yourself with the equipment in your shop. It is not important that you learn brand name equipment, only that you understand the theory behind the process on which your equipment operates.

Comment

I have always found that a solid foundation in basic photographic theory, camera operation, and film characteristics is a valuable asset as a DM. This information applies to many aspects of our job and is a natural extension of our creativity and visual literacy. Understanding tonal representation in photography also helps to understand tone as it applies to the printing process and CRT transmission. Study the Photographer's Mate (Basic) manual. It is well written and easily understood.

As with all processes, understanding how and why a process works unravels the mystery of operator adjustments. Machines are logical and predictable. Mastering reproduction equipment is essential. Knowing the processes required to achieve an end product makes the creation of the product easier.